SE04/125

PRV

PATENT- OCH REGISTRERINGSVERKET
Patentavdelningen

Intyg
Certificate

REC'D 28 APR 2004
WIPO PCT

Härmed intygas att bifogade kopior överensstämmer med de handlingar som ursprungligen ingivits till Patent- och registreringsverket i nedannämnda ansökan.

This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

(71)	Sökande Applicant	Telefonaktiebolaget L M Ericsson (publ), Stockholm, SE Carlsson, Roland, Öjersjö, SE Ankel, Pär, Nödinge, SE
(81)	Designerade stater Designated states	AP: all, EA: all, EP: all, OA: all, AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LI, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW
(21)	Patentansökningsnummer Patent application number	PCT SE03/02093
(86)	Ingivningsdatum Date of filing	2003-12-29

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Stockholm, 2004-04-23

För Patent- och registreringsverket
For the Patent- and Registration Office

Jan-Erik Karlsson

Avgift
Fee

Title

METHOD AND ARRANGEMENT RELATING TO COMMUNICATIONS NETWORK

The field of the invention

The present invention relates to a method and arrangement relating to tele communications and especially to power balancing in a communications network, in particular in a cellular network, e.g. based on Wideband Code Divisional Multiple Access (WCDMA), CDMA, or any other communications network with need for power balancing and adjustment.

The background of the invention

Wideband Code-Division Multiple-Access (WCDMA) is one of the main technologies for the implementation of third-generation (3G) cellular systems. It is based on the radio access technique proposed by ETSI Alpha group and the specifications was finalised 1999.

The implementation of WCDMA is a technical challenge because of its complexity and versatility. The complexity of WCDMA systems can be viewed from different angles: the complexity of each single algorithm, the complexity of the overall system and the computational complexity of a receiver. W-CDMA link-level simulations are over 10 times more compute-intensive than current second-generation simulations. In W-CDMA interface different users can simultaneously transmit at different data rates and data rates can even vary in time. UMTS networks need to support all current second-generation services and numerous new applications and services.

The WCDMA air interface has been standardized by 3rd Generation Partnership Project (3GPP) as a radio transport medium for global mobile communication systems. The specification allows superior user data rates and systems throughput capacities compared to any 2nd generation mobile communication standard. The adaptability of WCDMA system enables new ad significant evolutionary step in packet data access.

3rd Generation Partnership Project (3GPP), see for example 3GPP TS 25.433 V5.6.0 (2003-09): "Technical Specification Group Radio Access Network; UTRAN Iub

interface NBAP signalling (Release 5)", describes a procedure for handling Down Link (DL) power control, when handing over communication from one base station to another one, as illustrated in Fig. 1. Fig. 1 illustrates two cells 100a and 100b in a cellular communication network, such as a WCDMA. For each cell there is a radio access point 110a/110b. Access points in the UMTS-system are referred to as Node B. A Node B houses one or several radio transceivers and handles the radio-link protocols with the User Equipment (UE). Each Node B provides radio coverage in a specific area and therefore effectively defines the cell of the UMTS cellular system. In a large urban area, there will potentially be a large number of Node B(s) deployed. In the following, the access points are referred to as base stations 110a/110b, connected to a base station antenna 120a and 120b, respectively, transmitting and receiving signals to/from a transmitter device (User Equipment (UE)) 140. When handling over communication from one base station, e.g. 110a to 110b, the power between the base stations must be controlled and balanced. This means that the output power from base station 110b is set to substantially the level of base station 110a. This functionality is obtained through the network control (UTRAN).

The downlink transmit power control procedure, controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed. The relative transmit power offset between DPCCH fields and DPDCHs, is determined by the network. The TFCI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time.

The patent documentation is silence about a solution according to the present invention. However, power balancing between base stations is considered, e.g.: US 6,351,650 discloses forward power control during a soft handoff in a wireless communication system, accomplished by tracking each power command (PC) transmitted from a mobile unit to two or more base station transceiver systems (BTSs). Each BTS may interpret power commands differently due to noise. However, the power commands are relayed to a selector along with additional data transmitted in a conventional fashion. The selector determines the power levels of each BTS and transmits power charge commands to maintain power balance between the BTSs. The BTSs may transmit each PC command to the selector or accumulate several PC commands and send a PC history to the selector. The

selector generates a reference PC history, which may be one of the PC histories transmitted from a BTS, a combination thereof, and the result of data processing on the one or more PC histories. Individual power change commands or the reference PC history is transmitted back to the BTS to adjust the transmitter output level of each BTS so that the BTSs are transmitting at compatible signal levels

A transmit power load balancing technique in accordance with WO 02/23936 is used to increase the overall communication capacity of a radio communications system without incurring substantial, additional control signalling. An overloaded connection in a first cell serviced by a radio network is detected, and a second nearby cell, which is not overloaded, is identified. For a radio use node that has a connection with the radio network, radio transmission from the first overloaded cell is prevented or at least avoided in the downlink direction from the radio network to the radio use node. Instead, a radio transmission associated with that connection is established or otherwise permitted from the second cell in the downlink direction to the radio use node. The prevented or avoided downlink radio transmission is a traffic transmission. On the other hand, downlink control signalling associated with the connection from the first cell to the radio use node is permitted.

The summary of the invention

Fig. 2 illustrates a typical cell 200, for example in a WCDMA based communications network, comprising a base station 210, a base station antenna 220 and base station transceiver hardware 230. The base station hardware 230 may comprise several (physically separated) units 231 and 232, respectively, in this case, Tx1 and Tx2, respectively. Each transmitter comprises one or several hardware resources 233 and 234, respectively, such as a channel resource.

From time to time, it can be necessary to move a channel resource between two units, e.g. from Tx1 to Tx2. The relocation of the channel resources may depend on several reasons, for example:

- Maintenance: before removing one unit, channel resources in use are moved to another unit,
- Malfunction: if a hardware unit indicates a hardware failure, a channel resource is moved to another unit,
- Resource management:

- if a hardware unit has no further available resources or its maximum load, e.g. higher data rate, is reached, a channel resource can be allocated on another unit.
- Using additional radio link and additional transmitter units transmitting with same power.

Presently, when moving a resource from one hardware unit to another one, in the same base station, it is difficult to achieve the same power level in the new unit (Tx2) as in the old one (Tx1), especially when the power level is frequently updated. In WCDMA, the power level is updated every time slot (0.667 ms). Handling this requires faster communication between the units (transmitter 1 and 2) than the power update frequency. This implies that the faster interface and thus more expensive one must be provided between the hardware units. Otherwise, the power level of the new unit, i.e. Tx2 will be incorrect. Eventually, the Tx1 is turned off and Tx2 is turned on. The switching between the transmitters and their on and off states is performed synchronized. In mobile CDMA systems, for example, the power is changed rapidly, e.g. in fading environments.

Problems with existing solutions are, amongst others, the requirement for a fast interface between hardware units and if the hardware units are already manufactured and delivered, the difficulty of adding new interfaces.

Thus, the main object of the present invention is to provide a method and arrangement to solve the above-recognised problems, i.e. controlling power level when at least resources in same base station, specially channel resources are relocated between two hardware resources.

Surprisingly, it has been noted that the existing functionality (within 3GPP), normally intended for balancing power between two separate radio base stations, can be used to control the power level when handing over resources between two hardware units in one base station, i.e. balancing the power between at least two hardware units. The result is that the downlink power will not change (or be substantially the same) when switching over to a new hardware unit in the base station.

Other advantages of the invention include:

- Cost-effective solution in cases the hardware cannot be replaced or uppgraded; the need for new wiring in already installed equipment and additional interfaces in new equipment is eliminated
- The functionality already exists in the Radio Base Station's hardware and the control is already defined in 3GPP standard (see for example 25.433 UTRAN Iub interface NBAP signalling). Thus, no need for additional resources.

For above reasons, a method is provided for downlink power adjustment in a base station comprising at least two hardware units: a first unit and a second unit, in a communications network when moving a resource from the first unit to the second unit. The method comprises: configuring said resource, obtaining a sample of a power level, transferring said power sample from said first unit to said second unit and controlling the power level on the resource by a power control value calculated with turned off output power on said second unit.

Short description of the drawings

In the following, the invention is described with reference to a number of drawings illustrating some aspects of the invention in a non-limiting way, in which:

Fig. 1	is a schematic illustration of a cellular communication network according to prior art,
Fig. 2	is a schematic illustration of a base station according to preferred embodiment of the present invention,
Fig. 3	illustrates a preferred embodiment of a base station in more detail,
Fig. 4	illustrates a DL power sample in an exemplary DL Power Balancing algorithm,
Fig. 5	illustrates a DL power convergence of two resources, and
Fig. 6	illustrates a second preferred embodiment of a base station.

Abbreviations

For the purposes of the present document, the following abbreviations apply:

BCCH	Broadcast Control Channel
CCPCH	Common Control Physical Channel
CFN	Connection Frame Number
CPICH	Common Pilot Channel
DL	Downlink

DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
DSCH	Downlink Shared Channel
IPDL	Idle Periods in the Downlink
RL	Radio Link
RLS	Radio Link Set
RNC	Radio Network Controller
RRC	Radio Resource Control
TFC	Transport Format Combination
TFCI	Transport Format Combination Indicator
TPC	Transmit Power Control
UMTS	Universal Mobile Telecommunications System
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network

Detailed description of the preferred embodiments

In the following the invention is described with reference to a third-generation (3G) cellular telecommunication system, implementing WCDMA. However, the invention is not limited to the described and illustrated embodiments and can be implemented in any communication network allowing power balancing.

Power balancing and adjustment will be described more detail in conjunction with following three cases:

1. When the network (RNC) configures the power balancing in a WCDMA system (usually because several RLs are connected to one UE).
2. When the network has not configured power balancing.
3. When the Base Station needs to move a channel resource.

Block diagram of Fig. 3, illustrates a preferred embodiment of a base station 310 (Node B) in more detail, employing the power balancing arrangement, according to the present invention. The base station (disclosed very schematically) comprises an Interface Board 311, a RF coupler (and power splitter) 312 and a transmitter/receiver unit 315. The transmitter/receiver unit 315 includes

transmitter units 316a and 316b connected to a coder 317 and the RF coupler 312, and the receiver unit 318 is connected to a decoder 319 and the RF coupler 312.

The base station is connected to a Controller Unit 330, Network Controller (RNC) 340 and a base station antenna 350. It is appreciated that the function and functional units of an ordinary base station, and specially a WCDMA base station are known by a skilled person and thus not disclosed in detail herein, unless a specific entity contributes to the understanding of the invention.

The transmitter unit 316a (Tx1) is a Source transmitter. Transmitter unit 316b comprises one or several Destination units (cards). A control device 320, in this example realized as a switch is arranged to control the out of the transmitter units. The controller unit 330 controls the control device 320 through the interface board. It is also possible to integrate the interface unit and the controller unit.

The connection between a base station and a mobile unit may include communication via one or several radio links, which implies that same information is transmitted in several cells and the mobile unit can uses the information from these cells. According to one embodiment of the invention, one transmitter unit can generate all RLs to one mobile unit. However, it is possible to use one transmitter for each RL. This means that one transmitter unit can comprise several destination cards.

When a channel resource (or RL) is moved from Tx1 to Tx2, the channel resource is configured and a sample of the power level on the source unit is taken and transferred from Tx1 to Tx2. However, the sample can also be set without a need for an old sample, e.g. as a preset value. This allows making the power adjustment if the synchronization is lost. The power level on the new channel resource is from this moment power controlled, i.e. the power control value is calculated with turned off output power. Thus, the destination unit Tx2 is turned off, i.e. no output power during the power balancing or convergence period. This is one of the min differences between power balancing suggested by 3GPP and the present invention. Thus, the destination card does not affect the total signal transmitted to a mobile unit (cell phone) before it is ready to take over the transmission.

Thus, the invention also allows balancing power between several RLs within a base station.

When both hardware units are power balanced, the DL power-balancing is started on both units, controlled in same way.

DL Power Balancing compensates for power drift between different units during the handover. This is achieved by periodically adjusting the power by a step that is proportional in size to the offset between the used power and a reference power. Each adjustment is executed as a number of smaller adjustments applied over an adjustment period. The DL Power Balancing function performs the adjustments on a Radio Link (RL) basis. The RL is identified with the parameters "Resource1 ID" and "Resource2 ID". The function always performs the adjustments in a synchronous way.

After the reception of the parameters on the resource, the power adjustments are started at the first slot of a frame fulfilling "CFN" mod "Adjustment Period" = 0 and repeated for every adjustment period and restarted at the first slot of a frame with CFN=0.

According to Fig. 4, the sample of the "DL power" in the formula is performed on the pilot field immediately before the Adjustment Period subtracted with "Power offset of Pilot".

According to 3GPP, four parameters are used for controlling DL power balancing: *Adjustment Period, Adjustment Ratio, Max Adjustment Step and Reference power.*

Thus, according to case 1, when the network (RNC) configures the power balancing in a WCDMA system (usually because several RLs are connected to one UE), then the configured values of parameters such as "Adjustment Period", "Adjustment Ratio", "Max Adjustment Step" and "DL Reference Power" can be used to achieve some convergence between channel resources when relocation of a channel resource is performed. However, the convergence time depends on the setting of these parameters. To speed up the convergence time the base station can modify the parameter setting of some or all of them.

The power balancing adjustment is superimposed on the inner loop power control adjustment if activated. The power balancing adjustment is:

$\sum P_{bal} = (1-r)(P_{ref} + P_{P-CPICH} - P_{init})$ with an accuracy of ±0.5 dB

Wherein the sum is performed over an adjustment period corresponding to a number of frames equal to the value of the *Adjustment Period*, P_{ref} is the value of the *DL Reference Power*, $P_{P-CPICH}$ is the power used on the primary CPICH, P_{init} is the code power of the last slot of the previous adjustment period and r is given by the *Adjustment Ratio*.

If the last slot of the previous adjustment period is within a transmission gap due to compressed mode, P_{init} is set to the same value as the code power of the slot just before the transmission gap.

The adjustment within one adjustment period is in any case performed with the constraints given by the *Max Adjustment Step* and the DL TX power range set by the CRNC.

In order to guarantee a convergence, reducing the error by a factor, e.g. 2 every Adjustment Period, the Adjustment Ratio is set to e.g. 0.5.

If the change of hardware unit is triggered by RNC reconfiguration, e.g. for increasing data rate etc., there is typically 100 to 150 ms to execute the power balancing procedure.

After a while, the source unit (Tx1) turns off the power while the target unit (Tx2) turns on the power exactly simultaneously.

The power adjustments is started at the first slot of a frame with CFN modulo the value of *Adjustment Period* equal to 0 and is repeated for every adjustment period and restarted at the first slot of a frame with CFN=0, until a new DL POWER CONTROL REQUEST message is received or the RL is deleted.

As mentioned earlier, DL power balancing is used to make the DL power on two different hardware units converge. Independent of the current configuration, the following DL power balancing parameters are sent to new and old units (the parameter values are given as non-limiting examples):

- *DL Power Mode of the resource*, same as Current Power (CP) mode, but with DL Power Balancing.
- *Adjustment period* = 2 frames
- *Adjustment ratio* = 0.5
- *Max Adjustment step* = 1 slot (i.e. 1 dB/1 slot)

DL Transmission power on the new resource can be set to the received value from old RESOURCE for each RL.

DL transmission power is not changed on the old resource (if RL is assigned to a MS). If DL power balancing is activated the existing *"DL Reference Power"* is used. Optionally, if the network does not currently activate DL power balancing, *DL Power Reference* it is set to the same value as was received in parameter *"DL Transmission Power"* received from the old unit.

This setting is performed for each RL on both units:
With DL power balancing activated, the power on the two RLs will converge as both are regulated towards the same power level; this is illustrated in Fig. 5. Fig. 5 is an example of DL power convergence of two resources with DL power balancing during two adjustment periods. The arrows show the DL Power Balancing Adjustment.

In case constant DL power is used, the same power can be used on the new resource as on the old resource and as Reference power has the same value as the transmission power, there will be no adjustments, i.e. both resources will have same power. This is the case if the inner loop is disabled or the balancing is out of synchronization.

As both units use the same parameter settings, it can be shown that after "n" number of Adjustment Periods performed on both units the maximum error is:
(max [*Adjustment Ratio*, (1-*Adjustment Ratio*)])^n * P_{error} *at Adjustment period start.*

DL power balancing algorithm does not need to be started at the same time on both units. At the Adjustment Period start of the first period where both units perform balancing, the difference in power on the two units can in worst case be as large as the dynamic range (extreme case, e.g. > 20 dB). In most cases the power difference will be much smaller. The dynamic range is controlled due to the upper or lower power limits.

Assuming that there will be 5 Adjustment Periods where both units perform balancing and the dynamic range is 25 dB, the maximum error will be approximately $0.5^5*25= \pm 0.75$ dB.

Following definitions are used for calculation of error after an Adjustment Period:

$P_{old,n}$: Power of old TX unit at point n.

$P_{new,n}$: Power of new TX unit at measurement point n.

n: The point when a power balancing adjustment period is ended (n>0).

P_{ref}: Power reference used by power balancing.

K: 1-Adjustment Ratio

$P_{diff,n}$: Power difference at time n.

$P_{acc,n}$: Power change corresponds to accumulated TPC commands between n and n+1.

$P_{disc\_old,n}$: Power change corresponds to accumulated TPC commands that are discarded due to power limitations between n and n+1 for the old unit. This due to the upper or lower power limits (see fig. 4)

$P_{disc\_new,n}$: Power change corresponds to accumulated TPC commands that are discarded due to power limitations between n and n+1 for the new unit.

Calculated error after an Adjustment Period:

$$P_{old,n+1} = P_{old,n} - K*(P_{old,n} - P_{ref}) + P_{acc,n} - P_{disc\_old,n}$$

$$P_{new,n+1} = P_{new,n} - K*(P_{new,n} - P_{ref}) + P_{acc,n} - P_{disc\_new,n}$$

$$P_{diff,n+1} = P_{old,n+1} - P_{new,n+1} = P_{diff,n} - K*(P_{old,n} - P_{new,n}) - P_{disc\_old,n} + P_{disc\_new;n} =$$

$$(1-K) * P_{diff,n} - P_{disc\_old,n} + P_{disc\_new,n}$$

With $0 \leq P_{disc\_old,n} - P_{disc\_new,n} \leq P_{diff,n}$ ($P_{diff,n} \geq 0$)

$$-K*P_{diff,n} \leq P_{diff,n+1} \leq (1-K)*P_{diff,n}$$

(same result can be shown if $P_{diff,n} < 0$)

The adjustments described is done for each RL, according to following example:

A reference power is allocated to each BS and the DL power used by each radio link is periodically adjusted according to the pseudo code below. The result of this is that the BS's power levels slowly converge to the reference power. In this way the RBS power drift is reduced. This algorithm can be used when a connection is in Soft handover.

It is possible to change the DL Power Balancing method by the configuration parameter, in case the parameter value is No Balancing, the DL Power Balancing is turned off, but inner loop power control is running. If the parameter value is Balancing, the DL Power Balancing is turned on and running together with inner loop power control. If the parameter value is Fixed Balancing, the DL Power Balancing is turned on but a pre-configured value can be used as a DL Reference Power instead of calculated reference value. In this case, the inner loop power control can be disabled. If the parameter value is Fixed, the DL Power Balancing is turned off.

The reference power for the BSs must be calculated in the RNC. In order to have an even power split between the BSs the same reference power level must be sent to each RBS. The default case will be the even power split case. The reference power is calculated as the average of the measured values for transmitted code power from all involved RLs. The RL, which is out of sync, is excluded from the calculation. If all RLs are out of sync, the reference power sent last time is used as a reference power. The reason to exclude some RLs according to the uplink quality is that power drift occurs mainly due to the bad uplink condition.

The parameter Code_Power_Period decides both measurement period for transmitted code power and the period of sending new reference power to BSs. The averaging is done after removing the PCPICH (Power Common Pilot Channel) power from each of the reported (absolute) power levels. Also compensation for the power offset between DL DPDCH and the Pilot field of the DPCCH is done after the averaging. If the PCPICH Power information is not provided from DRNC during inter-RNC soft handover, a default Primary CPICH Power can be used. The first time (going from one RL to several) DL Power Balancing is started it is done using the initial power of the RL to be added as reference power (to avoid delays from waiting for measurements from the RBSs). An additional parameter is used to adjust the reference power for users in compressed mode.

The DL Power Balancing is done in a synchronized way. As mentioned earlier, this is achieved by restarting a new Adjustment Period whenever

mod(CFN, AdjustmentPeriod)=0

e.g. in the case of Adjustment Period = 100 a new Adjustment Period is started at CFN={0, 100,200}. Also the DL Power Balancing is restarted at the first slot of a frame with CFN=0.

If there is a transmitted code power measurement report from the new RL, it will be ignored in SRNC. The RBS part of DL Power Balancing algorithm is implemented in DL power setting algorithm, in accordance with the following:

As described earlier, the power balancing adjustment to be performed during the "Adjustment Period" is defined as $\sum P_{bal}$. The adjustment can be implemented according to the following:

With a power step size of x dB, y power adjustments are performed preferably evenly distributed over the "Adjustment Period", where:

$$y = \left(\sum P_{bal}\right) / x .$$

The power adjustments that results of the DL Power Balancing algorithm, is applied at the timeslot start.

When the power mode is "DL Inner-loop + DL Power Balancing" power mode, the resulting DL power change for each slot is the sum of the "DL Power Balancing" power change (actually applied at the timeslot start) and the TPC from the "DL Inner-loop Power Control" (actually applied at the pilot field, Fig. 4).

The power limits (upper, lower) are from *"DL Inner-Loop Power Control".*

Block diagram of Fig. 6, illustrates another preferred embodiment of a base station 610 (Node B), employing the power balancing arrangement, according to the present invention. The base station (disclosed very schematically) comprises transmitter units 616a and 616b connected to a controller unit 630. The base station is connected to a Network Controller (NC) 640. It is appreciated that the function and functional units of an ordinary base station is well known by a skilled person and not disclosed in detail herein, unless a specific entity contributes to the understanding of the invention.

The transmitter unit 616a is a Source transmitter while transmitter unit 616b comprises Destination card and additional RLs.

The base station according to this embodiment is used when an RL is added to the network, i.e. a new cell, and the base station is urged to transmit with same power into the new cell as the previous cell.

Also in this case a power balancing is conducted in same manner as the above-mentioned example. However, the control unit directly controlled the transmitters and executes the power balancing and adjustment procedure as mentioned earlier.

Thus, according to case 2, if the network has not configured power balancing (valid for all communication systems allowing power balancing), the Base Station itself can turn on balancing, during movement of a channel resource.

If the Base Station needs to move a channel resource according to case 3, it can send an indication to the network (RNC), requesting the RNC to turn on power balancing on all RLs connected to a mobile unit. The gain by this is that all RLs connected to a mobile unit will power balance the DL power towards the same "DL Reference Power" using the same parameter values. For WCDMA this would require an addition to the Iub interface, described in ref 25.433 (NBAP).

The invention is not limited to the shown embodiments but can be varied in a number of ways without departing from the scope of the appended claims and the arrangement and the method can be implemented in various ways depending on application, functional units, needs and requirements etc.

CLAIMS

1. A method for downlink power adjustment in a base station comprising at least two similar hardware units: a first unit and a second unit, in a communications network when moving a resource from said first unit to said second unit, the method comprising:
   - configuring said resource,
   - providing a sample of a power level,
   - transferring said power sample from said first unit to said second unit, and
   - controlling the power level on the resource by a power control value calculated with turned off output power on said second unit.

2. The method of claim 1, wherein said resource is a channel resource.

3. The method of claim 1 or 2, wherein said hardware units are transmitter units.

4. The method according to any of preceding claims, wherein said downlink Power Balancing compensates for power drift between different units during handover.

5. The method of claim 4, wherein said compensation is achieved by periodically adjusting the power by a step that is proportional in size to an offset between a used power and a reference power.

6. The method of claim 5, wherein each adjustment is executed as a number of smaller adjustments applied over an adjustment period.

7. The method of claim 5, wherein said downlink Power Balancing is performs the adjustments on a Radio Link (RL) basis.

8. The method of claim 7, wherein the adjustments are performed synchronously.

9. The method of claim 7, wherein the power balancing adjustment is superimposed on an inner loop power control adjustment if activated.

10. The method of claim 9, wherein the power balancing adjustment is:

$$\sum P_{bal} = (1-r)(P_{ref} + P_{P-CPICH} - P_{init})$$

wherein the sum is performed over an adjustment period corresponding to a number of frames equal to a value of an *Adjustment Period*, P_{ref} is the value of *DL Reference Power*, $P_{P\text{-}CPICH}$ is the power used on a primary Common Pilot Channel, P_{init} is a code power of a last slot of a previous adjustment period and r is given by an *Adjustment Ratio*.

The method of claim 11, wherein a power step-size of x dB, y power adjustments are performed preferably evenly distributed over an Adjustment Period, where:

$$y = \left(\sum P_{bal} \right) / x .$$

11. The method of claim 1, wherein the sample of power level is obtained from the first unit.

12. The method of claim 1, wherein the sample of power level is preset.

13. The method of claim 1, wherein if the network (RNC) configures power balancing in a system having several RLs connected to one mobile unit, then configured values of system specific parameters ("Adjustment Period", "Adjustment Ratio", "Max Adjustment Step"; "DL Reference Power") are used to achieve convergence between channel resources when moving of a channel resource is performed.

14. The method of claim 13, wherein a convergence time depends on setting of said parameters, which can be modified by said base station to speed up convergence time.

15. The method of claim 1, wherein if the network has not configured power balancing, said base station itself turns on balancing, during movement of a channel resource.

16. The method of claim 1, wherein if said base station needs to move a channel resource, it sends an indication to the network (RNC), requesting the RNC to turn on power balancing on all radio links connected to a mobile unit.

17. A data structure used in a computer generated instruction set for power balancing method of claim 1, said data structure comprising a pilot field, first and second Dedicated Physical Data Channels (DPDCH), Transport Format Combination, and Indicator Transmit Power Control, second DPDCH being arranged previous in to said pilot field, wherein a downlink increase/decrease is applied before pilot field.

18. The data structure of claim 17, wherein a sample is taken at said pilot field before an adjustment period subtracted with a pilot power offset during an adjustment period.

19. In a communications network, a base station (310, 610) comprising at least two hardware units (316a, 316b; 616a, 616b), a first and a second hardware unit, and a controller unit (330, 630), said base station being arranged to allow handover of recourses between said hardware units,
characterised in
that controller unit is arrange to adjust power between said hardware units, said controller unit comprising a processor unit for configuring said resource, obtaining a sample of a power, transferring said power sample from said first hardware unit to said second hardware unit and means for controlling the power level on the resource by a power control value calculated with turned off output power on said second unit.

20. The base station of claim 19, wherein said network is WMCDA based network.

21. The base station of claim 20, being connected to Radio Network Controller.

22. The base station of claim 19, wherein said hardware units are transmitter units.

23. The base station of claim 18, wherein said resource is a channel resource.

24. The base station of claim 19, wherein said base station transmits into two cells in said network.

25. The base station of claim 19, wherein said handover is under addition of a new cell.

26. The base station of claim 19, further comprising a controller (320) for connecting and disconnecting outputs from said transmitter units to a base station output.

Abstract

The present invention relates to a method for downlink power balancing in a base station (310, 610) comprising at least two similar hardware units (316a, 316b, 616a, 616b): a first unit (316a, 616a) and a second unit (313b, 616b), in a communications network when moving a resource from said first unit to said second unit. The method comprises: configuring said resource, obtaining a sample of a power level, transferring said power sample from said first unit to said second unit and controlling the power level on the resource by a power control value calculated with turned off output power on said second unit.

(Fig. 3)

PCT/ SE 03/02093

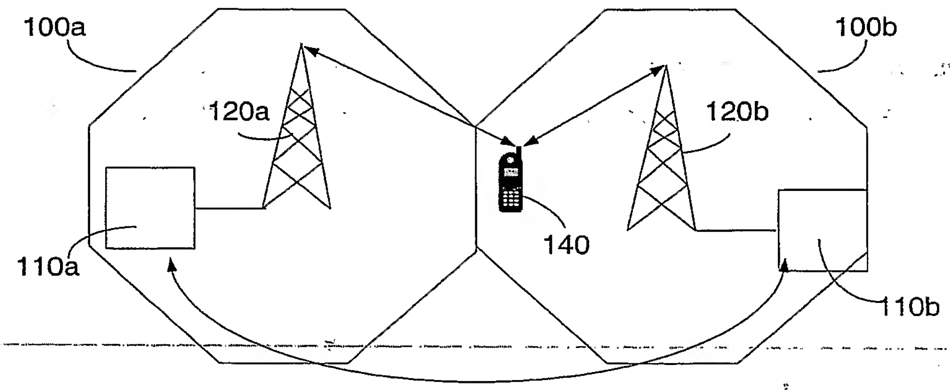

Fig. 1

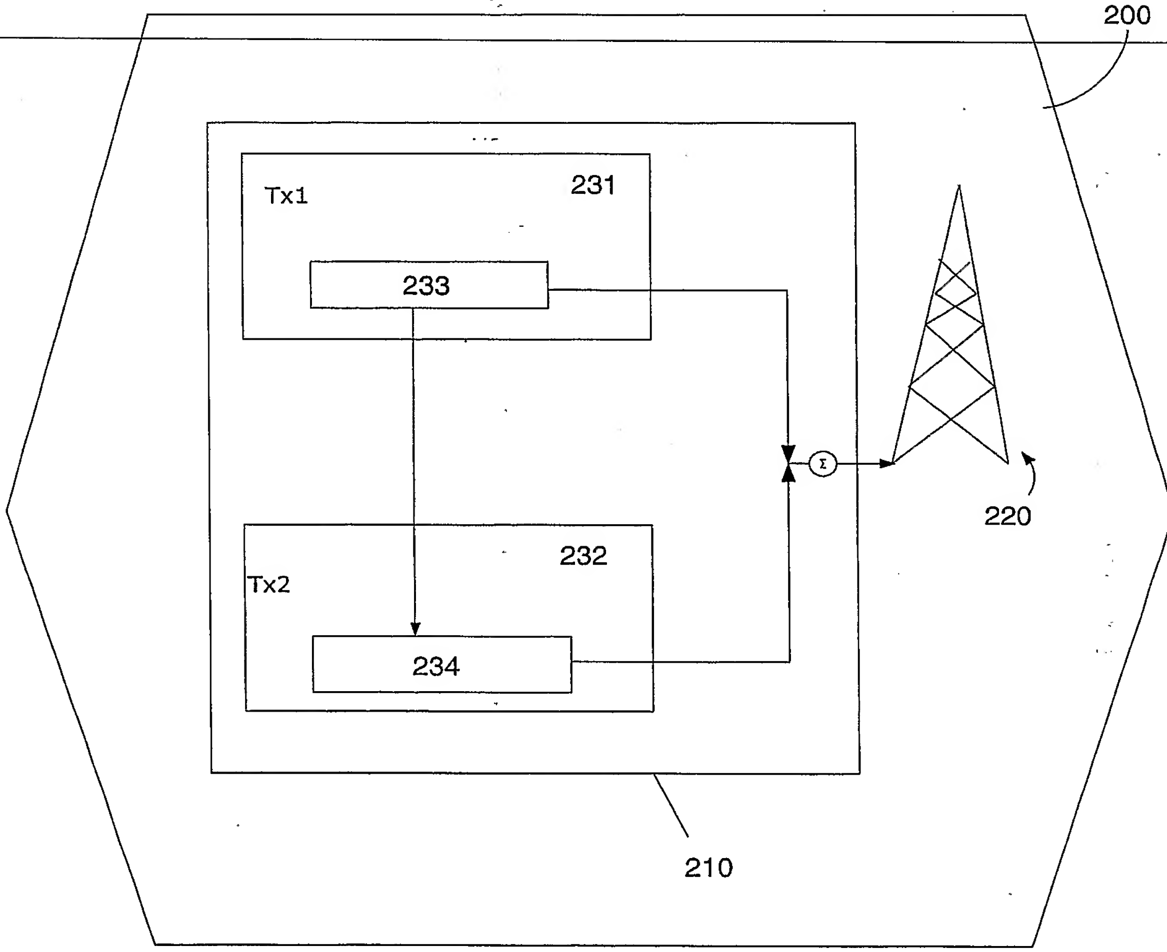

Fig. 2

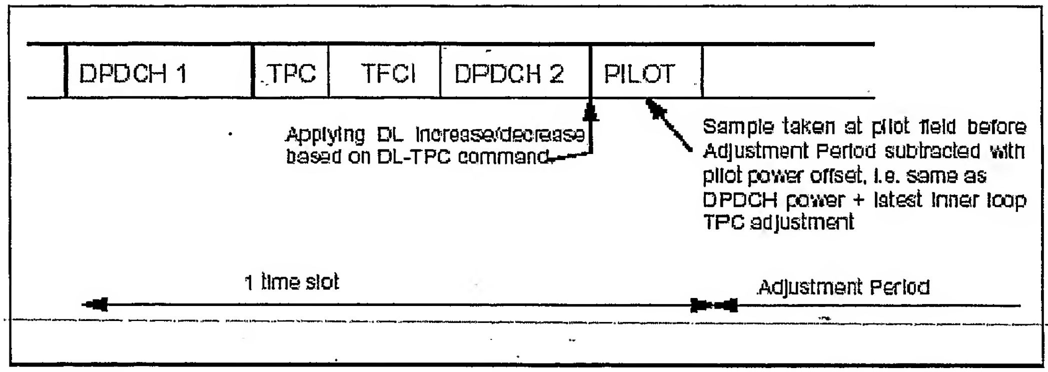
DPDCH 1
TPC
TFCI
DPDCH 2
PILOT
Applying DL increase/decrease based on DL-TPC command
Sample taken at pilot field before Adjustment Period subtracted with pilot power offset, i.e. same as DPDCH power + latest inner loop TPC adjustment
1 time slot
Adjustment Period

Fig. 4

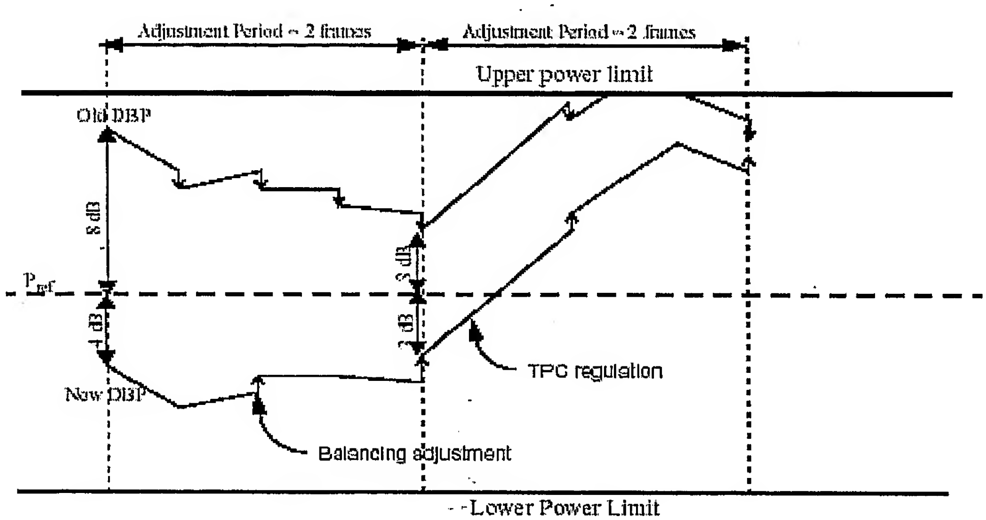
Adjustment Period ~ 2 frames
Adjustment Period ~ 2 frames
Upper power limit
Old DBP
8 dB
P_{ref}
4 dB
3 dB
2 dB
New DBP
TPC regulation
Balancing adjustment
Lower Power Limit

Fig. 5

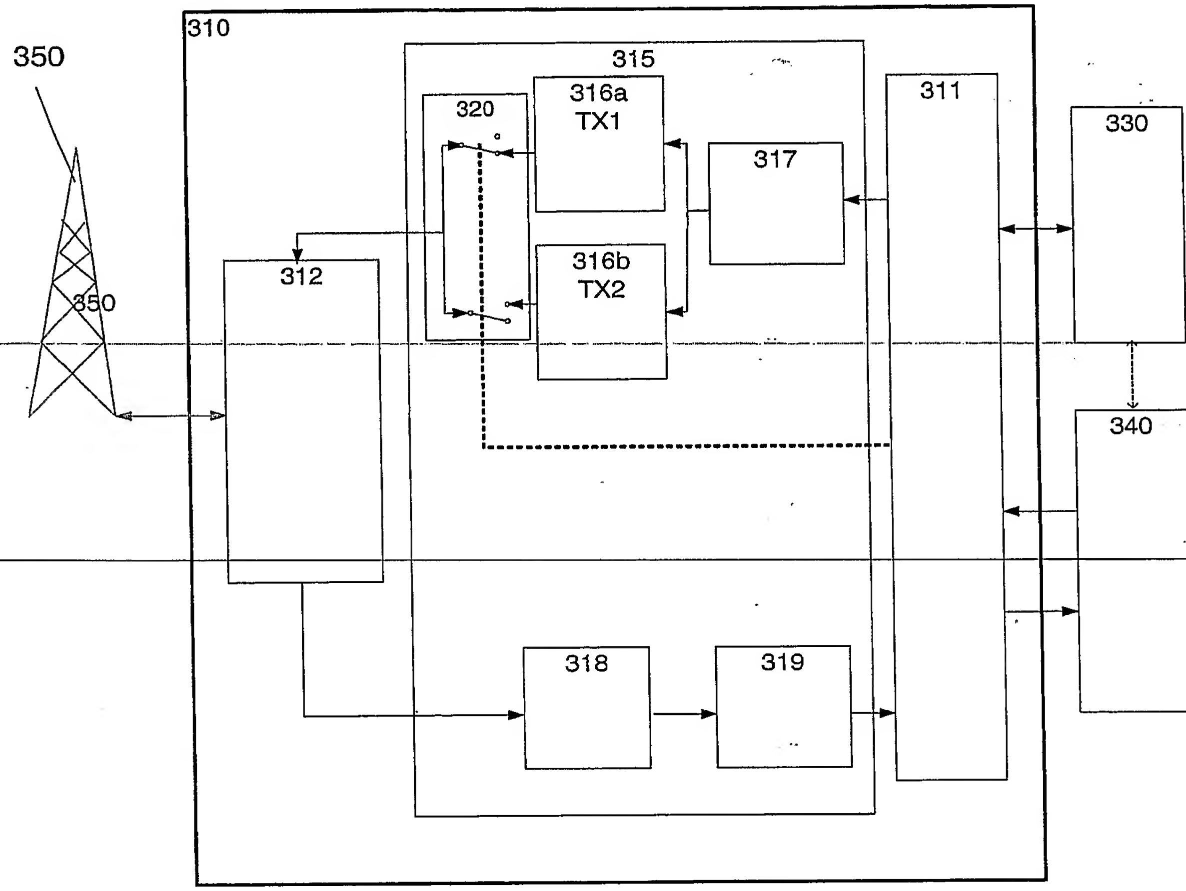
350
310
315
320
316a
TX1
317
311
330
312
316b
TX2
350
340
318
319

Fig. 3

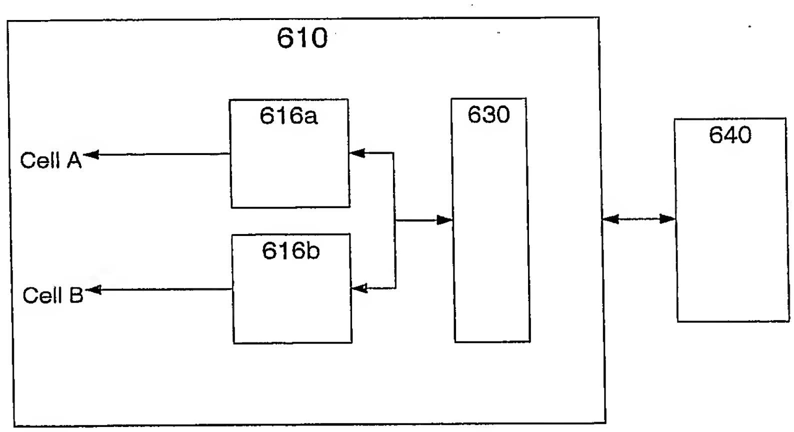
610
616a
630
640
Cell A
616b
Cell B

Fig. 6